GNG 1103: Deliverable H

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1. Introduction

The objective of deliverable H is to develop the third and final prototype, devise a plan to test the prototype and receive constructive feedback from the client, and the supervisor on the prototype for our team's bed frame. The document goes over the general project plan: how we use the results from the second prototype to develop this prototype, the prototype design, testing methodology and feedback on the prototype.

1.1 What?

Create a full-scale final prototype based off the second prototype, test and evaluate it on each of our design metrics and obtain feedback on the final design.

1.2 Why?

We are using a prototype as an early sample model of our product to be built to bring our concept to life and to test our concept so that it can be learned from, and using the feedback that we obtain from the instructors, we will maximize the functionality of our bed.

1.3 When?

Our final design is to be built, tested, and delivered on Friday, March 29th.

2. Client Feedback From Prototype Two

Our client was very satisfied with our second prototype and had no additional suggestions on how we could make it better fit the needs of the project. Thus, we moved ahead with our design from prototype 2 unchanged, going into the building stage.

3. Prototype Three

3.1 Changes to Prototype Three

Though there were no changes to the design from the second prototype, during the construction phase of this final model, we discovered issues with the design and additional improvements that could be made. One of the problems we noticed were the corner edges of the legs, which was that they were very weak. Originally we planned to glue the side pieces together flush to each other, to solve the problem we came up with the interlocking tabs design, and implemented that on all joints of our leg pieces. This change provided the legs with more rigidity and strength. Additionally since we were able to repurpose

some of the scrap material to reinforce the tips of our legs (triangle parts) at no additional material cost, we decided to add this to the design. We had planned to have the length of the slats be slightly longer than half of the bed, but found that it was more material efficient to have long slats that were the length of the cardboard sheets as well as shorter slats that were long enough to cover the rest of the length of the bed, so this alteration was made.

3.2 Images of Final Prototype

Figure 1. Completely Assembled Bed

Figure 2. Front View of of the Bed Frame

Figure 3. Top View of the Bed Frame

3.3 Feedback on Prototype 3

Overall, there was a generally positive response to the final prototype. However, there was one suggestion that could be applied. The larger legs had raised sides to fence in the mattress. We had only made this raised side one sheet of cardboard thick. We realized that the sides were susceptible to bending when pressure was applied outward. Thus we could further improve the design by reinforcing the spot that is prone to bending by adding more layers of cardboard either specifically right at the spot, or increasing the layers for the entire side of the leg.

4. Prototyping Test Plan

Table 1. List of Metrics to Test

Metrics	Units	Client's Perception/ Technical Performance
1. Weight bed frame is able to support	lbs	The bed must be able to hold a weight of at least 250 pounds
2. Compaction Ratio	%(cm^3)	The bed is to be folded and or taken apart and packed up into one unit to be relatively lightweight, easily carried and transported. The compact size should be no more than 50% of the original volume
3. Dimensions of the Bed	cm	Must be able to hold a standard twin size mattress (187cmx92cm), while being 60 cm off the ground.
4. Easy and Quick to Operate	Minutes	The design should be time efficient. The design should not burden the client to assemble or disassemble the bed. Specifically, it can be done by no more than two people in under 5 min
5. Stability to transmit various loadings safely to the ground.	Yes/No	The bedframe is able to be used without rocking or instability.
6. Cost	$CAD	The product needs to be cost effective and fit within the budget of $100

4.1 Testing Methodology

(Metric 1) To test the strength of our design, we first started with a static load, beginning with a single adult that was roughly 250lbs. The stopping criteria was when the bed could hold 250lbs. (Metric 2) To test how much the bed frame could compact to, we compacted the frame as much as possible (nesting as much as possible etc.) then measured the volume of space it took up. If it was 50% or less of the original volume, it passed the test. (Metric 3) We measured the fully assembled bed and compared it to the criteria to see if it passed. (Metric 4) We assembled the bed as quickly as possible and timed the process. If the

time was less than 5 minutes, we stopped the testing as the bed passed the criteria. (Metric 5) On the fully assembled bed, one person sat on the bed and rocked their body back and forth and side to side. If the bed shifted in any direction less than 5 cm away from the original position, the bed passed the criteria. (Metric 6) If the cost of the bed frame was equal to or less than $100, it passed the criteria.

4.1 Results of Testing

We found our design to be capable of holding in excess of 800 lbs of weight. This far exceeds our original goal and is expected to be able to hold a considerably greater weight. The quickest time it took to fully assemble the bed was under 2 minutes, which passed the criteria. The frame was able to hold a standard twin size mattress perfectly and so it passed the criteria. When the bed was rocked, it moved at most 2 cm from its original position. We found that the ratio of the bed frame' expanded volume compared to its collapsed volume was less than 50%, which meets our design criteria. Our final cost for the bed was $90, which is 10% under budget.

5. Conclusion

In conclusion, the bed frame design was successful in fulfilling the client's needs. The prototype satisfied the client as it was both functional and aesthetically pleasing. Based off the metrics being tested, the bed frame not only passed all of the standards, but also excelled in many of them. A glaring weakness of our design is that the construction time to create a bed frame can take up to 24 hours. If an effective manufacturing process for the bed frame was created, not only would the time it takes to create a bed frame would be reduced, so would the cost of an individual bed frame. Overall, the bed frame created by our team is extremely effective and our client is satisfied with the product.